

## **SPECIAL PROVISION FOR WELDING STEEL BRIDGES**

This Special Note will apply when indicated on the plans or in the proposal. Section references herein are to the Department's 2004 Standard Specifications for Road and Bridge Construction.

For all the welding, welders, welding materials, and welding procedures, conform to the requirements of the Bridge Welding Code, ANSI/AASHTO/AWS D1.5-95, and the modifications and additions herein.

The numbering of the sections, articles, parts, paragraphs, etc. that are included hereinafter are based on the numbering of ANSI/AASHTO/AWS D1.5-95. The plans or proposal will include additional requirements for fracture-critical members, and may include additional requirements for special steels such as ASTM A 588 (AASHTO M 222).

### **SECTION 1 GENERAL PROVISIONS**

Paragraph 1.0 is added as follows:

#### **1.0 Prequalification of Fabrication Shops**

1.0.1 Any structural steel fabrication shop in which welded plate girders, or welded boxes or components for bridge trusses, rigid frames, or bridge arches are fabricated shall be qualified and certified as a Category III fabrication shop by AISC.

Proof of this qualification and certification shall be submitted to the Director, Division of Bridges, prior to or along with the first submission of shop drawings. Shop drawings will not be reviewed until this proof has been received.

#### **1.3 Welding Processes**

Paragraph 1.3.1.1 is added as follows:

Gas Metal Arc (GMAW), Flux Cored Arc (FCAW), Electroslag (ESW), and Electrogas (EGW) weld processes shall not be used at any location.

### **SECTION 2 DESIGN OF WELDED CONNECTIONS**

#### **2.1 Drawings**

Paragraph 2.1.6 is added as follows:

Shop drawings and welding procedures shall be prepared and submitted for review as specified in Section 607.04 of the Department's Standard Specifications. Fabrication shall not begin until shop drawings and welding procedures are reviewed.

#### **2.6 Joint Qualification**

The following is added to Paragraph 2.6.1:

Details of welded joints shown on the design drawings may indicate joint preparation for a manual shielded metal-arc process or for a submerged-arc process. Shop details shall indicate the proper joint preparation for the welding procedure proposed by the shop in instances where the shop prefers a method not detailed on design drawings.

## 2.8 Details of Plug and Slot Welds

Plug and Slot Welds will not be permitted at any location in any type of steel except where designated on the plans or approved by the Engineer.

## 2.9 Complete Joint Penetration Groove Welds, and

## 2.10 Partial Joint Penetration Groove Welds

The following paragraph is added to the 2 articles listed above and will be numbered as follows:

2.9.3 – 2.10.4 Groove welds, except corner and tee joints, shall be finished smooth by grinding each face in the direction of applied stress to a tolerance of plus 1/32 inch and minus zero inch in relation to the face of the base metal.

# SECTION 3 WORKMANSHIP

## 3.1 General Requirements

Paragraph 3.1.6 is added as follows:

Any discontinuities found by the Engineer during the inspection of the fabrication, may lead to further testing by any non-destructive methods as may be directed by the Engineer. The cost of testing will be at the expense of the Department, except as specified in paragraphs 6.5.8 and 6.5.9 herein, and Section 607.15 of the Department's Standard Specifications. The cost of removal and repair of any rejectable discontinuities will be borne by the Contractor.

## 3.2 Preparation of Base Metal

The following is added to Paragraph 3.2.1:

Mill scale and extraneous material shall be removed from the torch side of ASTM A 514 (AASHTO M 244) steel plates along the lines to be flame cut, when necessary to obviate excessive notches.

Paragraph 3.2.10 is added as follows:

Sheared plates to be used for webs of built-up members shall be ordered with sufficient additional width to allow for trimming of edges where built-up camber is required. Plates with rolled edges shall be trimmed. Universal mill plates to be used for webs of built-up members shall be ordered with sufficient additional width to allow for trimming of both edges. The faying surfaces of the web and flange plates and the adjacent surfaces that are to be fillet welded shall be cleaned by grinding prior to assembly and welding of web-to-flange. Care shall be exercised to avoid over-grinding.

## 3.4 Control of Distortion and Shrinkage

Paragraphs 3.4.8 is added as follows:

The welding sequence outlined in the procedure specification shall be such as to avoid needless distortion and shrinkage stresses in accordance with this Article 3.4. For welded plate

girders the broad outline of sequence shall be as follows:

1. Flange groove weld
2. Web groove weld
3. Web to flange weld
4. Stiffeners to web welds
5. Stiffeners to flange welds

Paragraph 3.4.9 is added as follows:

All welded shop splices in flanges and webs of girders or frames shall be shown on the shop drawings.

### 3.7 Repairs

Paragraph 3.7.2.5 is added as follows:

Weld repairs of all material except fracture critical members will be limited to a maximum of 3 attempts to obtain an approved weld. No further attempts shall be made on the member joint involved until the Contractor has proven to the Inspector, by mock-up procedures or otherwise, his ability to properly perform the required weld. Weld repairs on fracture critical members shall comply with the AASHTO Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members.

## SECTION 4 TECHNIQUE

### PART B SHIELDED METAL ARC WELDING

#### 4.5 Electrodes for Shielded Metal Arc Welding

Paragraph 4.5.1 is voided and replaced as follows:

All electrodes for shielded metal arc welding shall conform to the requirements of the latest edition of Specification for Covered Carbon Steel Arc Welding Electrodes, ANSI/AWS A5.1 or Specification for Low Alloy Steel Covered Arc Welding Electrodes, ANSI/AWS A5.5, and when used for welding on main members shall be capable of producing weld metal having an impact strength of at least 20 ft.-lbs.. Charpy V-notch, at a temperature of -20 °F or below.

The following is added to Paragraph 4.5.5:

The fabricator shall furnish a test report summary for all lots of electrodes used on main members. All Charpy impact strengths shall be listed in addition to other requirements of ANSI/AWS A5.1 and ANSI/AWS A5.5.

### PART C SUBMERGED ARC WELDING

#### 4.8 Electrodes and Fluxes for Submerged Arc Welding

Paragraph 4.8.5 is added as follows:

Flux which shows evidence of moisture pickup shall be dried by heating to above 300 °F for a minimum of 2 hours. Flux which has been left in an unheated dispensing system overnight shall be dried before use by heating to above 300 °F for one hour.

#### 4.9 Procedures for Submerged Arc Welding with a Single Electrode

Paragraph 4.9.2 is voided and replaced as follows:

Web to flange fillet welds shall be made in the flat position. Other fillet welds may be made in either the flat or horizontal position except that single-pass fillet welds made in the horizontal position shall not exceed 5/16 inch. Fillet welds used to connect flange plates to web plates shall be made with a single pass, fully automatic process in the flat position, unless the fabricator has special welding fixtures capable of supporting the flange in a horizontal plane while centering the web on the flange and simultaneously welding both sides of the web to flange connection. The use of this automatic welding fixture must have prior approval before beginning fabrication. This special welding fixture must be capable of maintaining any pre-cut camber specified in the plans. If the centering of the web to the flange or the completed weld does not conform to the applicable specifications, use of the special welding fixture shall be discontinued. Girder welding machines shall never be allowed when the weld size exceeds 3/8 inch. Attempts to weld girders with a girder machine that result in unacceptable weld profiles will result in the process being disapproved, and the unacceptable welds being completely removed and rewelded with submerged arc process in the flat position. Corrective work will not be allowed.

#### 4.11 Procedures for Submerged Arc Welding with Multiple Electrodes

Paragraph 4.11.2 is voided and replaced as follows:

Web to flange fillet welds shall be made in the flat position. Other fillet welds may be made in either the flat or horizontal position, except that single-pass fillet welds made in the horizontal position shall not exceed 1/2 inch. A fully automatic single-pass submerged arc shall be used to connect the flange plates to the web plates, unless the fabricator has special welding fixtures capable of supporting the flange in a horizontal plane while centering the web on the flange and simultaneously welding both sides of the web to flange connection. The use of this automatic welding fixture must have prior approval before beginning fabrication. This special welding fixture must be capable of maintaining any pre-cut camber specified in the plans. If the centering of the web to the flange, or the completed weld, does not conform to the applicable specifications, use of the special welding fixture shall be discontinued. Girder welding machines shall never be allowed when the weld size exceeds 3/8 inch. Attempts to weld girders with a girder machine that result in unacceptable weld profiles will result in the process being disapproved, and the unacceptable welds being completely removed and rewelded with submerged arc process in the flat position. Corrective work will not be allowed.

## **SECTION 5 QUALIFICATION**

### **5.7 General Requirements for WPS Qualifications**

Paragraph 5.7.1.3 is added as follows:

The procedure specifications shall be recorded as a part of the shop detail drawings and shall be submitted to the Director of Bridges for approval. The procedure specifications shall outline the welding sequence for each welded shop assembly, including shoes and rockers. The procedure specifications shall specify for each type of weld, prequalified or other, the following: joint preparation, fit-up, electrode specification, electrode diameter, welding position, polarity, amperage, and number of passes, indicating any procedure change from one pass to the next in the same weld and indicating the maximum thickness in a weldment layer. Where preheating of the base metal is required it shall be indicated in the procedure specifications. Extension bars used in making butt welds shall be detailed on the shop detail drawings or on the welding procedures. Procedure specifications submitted which are not tailored to suit the particular work to be fabricated shall not be considered as fulfilling the requirements of the contract. Qualification of a welding procedure established with ASTM A 441, ASTM A 572 (AASHTO M 223), or ASTM A 588 (AASHTO M 222) steel shall be considered as procedure qualification for welding the other two steels, combinations of them or with steels included in Article 9.2 having a lower minimum specified yield point.

Welding of ASTM A 242 steel is considered a special application and a welding procedure qualified for any of the other three steels listed may not be acceptable for A 242 steel.

Procedure qualification records, and procedure specifications shall be submitted on forms E-1 and E-2 of Appendix IV.

### **5.21 Welders, Welding Operators, and Tack Welders Qualification**

Paragraph 5.21 is voided and replaced as follows:

All welders, welding operators, and tackers to be employed under these Specifications shall have been qualified by tests as prescribed in Section 5, Part B of these Specifications. If a fabricating shop prequalifies its welders, welding operators, and tackers in accordance with these Specifications and certifies to the Engineer that the welder, welding operator, or tackler has been prequalified within 24 months previous to the beginning of work on the subject structure and has been doing satisfactory welding of the required type within the 3-month period previous to the subject work, the Engineer may consider him qualified. A certification shall be submitted for each welder, welding operator, or tackler and for each project, stating the name of the welder, welding operator, or tackler, the name and title of the person who conducted the examination, kind of specimens, the position of welds, the results of the tests, and the date of the examination. Such a certification of prequalification may also be accepted as proof that a welder, welding operator, or tackler is qualified, if the Contractor who submits it is properly staffed and equipped to conduct such an examination or if the examining and testing is done by a recognized agency which is staffed and equipped for such purpose. In all cases, welders, welding operators, and tackers shall have been qualified by testing according to KM 64-110 within the previous 24 months of the time of actual weld performance.

## **PART B WELDER'S, WELDING OPERATOR'S, OR TACK WELDER'S QUALIFICATION**

Article 5.21.4 is voided and replaced with the following:

#### 5.21.4 Period of Effectiveness

The welder's, welding operator's, or tack welder's qualification will remain in effect as specified in Paragraph 5.8.1, unless there is some specific reason to question a welder's ability.

### **SECTION 6 INSPECTION**

#### **PART A GENERAL REQUIREMENTS**

##### 6.1 General

Paragraph 6.1.1.3 is added as follows:

The Contractor shall submit details of his Quality Control Organization to the Director, Division of Construction, for approval prior to any fabrication. Any material fabricated prior to the approval of the Quality Control Organization or prior to the approval of shop drawings will not be accepted.

The Department will normally perform Quality Assurance (Q.A.) inspection and nondestructive testing in addition to that required to be performed by the Contractor. The frequency of the Quality Assurance nondestructive testing may exceed that required of the Contractor, and the areas tested by the Department may differ from the areas tested by the Contractor. Thus, the percentage of N.D.T. Inspection of a joint may exceed the percentages indicated in paragraphs 6.7.1.2 and 6.7.2.1.

All test results of the Contractor's nondestructive testing shall be provided to the Department's representative or Quality Assurance inspector as directed.

Paragraph 6.1.1.4 is added as follows:

Prior to the start of actual welding operations, the Department's inspector, the fabricator's shop inspector, and welding foreman shall hold a conference to ensure that agreement has been reached regarding details of the procedure and sequence of welding to be followed, the current status of qualification tests or evidence of previous tests, the review status of shop drawings and welding procedures, and approval of electrodes and other materials to be used.

Paragraph 6.1.6 is added as follows:

The Department's Q.A. Inspector will, at his option, use Radiographic Inspection or Ultrasonic Inspection in accordance with Article 6.7 for the inspection of groove welds. Web-to-flange fillet welds will be inspected in accordance with Paragraph 6.7.6 by Magnetic Particle Inspections. The intent of the inspection is to assure the highest quality of welding and workmanship. Any discontinuities found by the Department's Q.A. Inspector during the inspection of the fabrication, may lead to further testing by any non-destructive methods as may be directed by the Engineer. All non-destructive testing performed by the Department's Q.A. Inspector is at no direct cost to the Contractor except as specified in Paragraph 6.5.9 and Section 607.15 of the Department's Standard Specifications. All rejectable defects found by Q.C. and Q.A. shall be acceptably repaired by the Contractor at no cost to the Department.

##### 6.5 Inspection of Work and Records

Paragraph 6.5.8.1 is added as follows:

The Contractor shall be responsible for establishing an adequate procedure for identifying the structural member being fabricated and the welding operator performing the weld. The procedure for the member identification shall assure positive identification until after erection in the field and the procedure for welding operators shall assure positive identification until after all nondestructive testing of the joint is complete. Neither procedure shall consist of stressrider imprints and both shall be approved by the Engineer. Stenciled imprints may be made along side edges of flanges, and at neutral axes of webs. Subsequent to the assembly of the steel into final members or pieces, the Inspector will be required to furnish the Engineer a complete index properly identifying the type of nondestructive test, report number, test results, and the final mark of the piece, member, or its location in the structure. The Contractor shall furnish to the Inspector assembly marks for each member which will give the final location of each weld. The Inspector shall record the locations of inspected areas and the findings of all nondestructive tests, together with descriptions of any repairs made.

All main member heat numbers will be required to be identified in accordance with Section 607.07 (E) of the Department's Standard Specifications.

The Inspectors shall provide copies of the written nondestructive test reports of unacceptable welds to the Contractor with the Inspector's interpretation. The Contractor shall sign and date each report to acknowledge the required welding repairs. In the event the Contractor questions the Inspector's interpretation of test results, they shall review the test together and the Department's Q.A. Inspector's interpretation will be final.

Paragraph 6.5.9 is added as follows:

The total cost to the Department of all additional testing and visual inspection performed due to the finding of rejectable defects or discontinuities as required by paragraphs 6.7.1.2(2) and 6.7.2.1 shall be charged to the Contractor. Such charge will be deducted from any payment or payments due for the contract.

#### 6.6 Obligations of Contractor

Paragraph 6.6.7 is added as follows:

While every reasonable effort will be made to fit the inspection work to the shop fabricating schedule, the Contractor shall cooperate with the Inspector to assure that all the work may be inspected properly. The Contractor shall not be entitled to claims against the Department for extra payment or extensions of contract time due to fabricating delays or expenses resulting from the inspection work.

Paragraph 6.6.8 is added as follows:

The Contractor shall furnish power and utilities for operating inspection equipment, shall provide office and shop space for the inspection work, shall handle the material as necessary and shall enforce the required safety precautions for radioactive exposure. No extra payment will be made for such incidentals and the cost thereof shall be included in the lump sum bid for structural steel.

### **PART B RADIOGRAPHIC TESTING OF GROOVE WELDS IN BUTT JOINTS**

#### 6.10 Radiographic Procedure

Paragraph 6.10.3 is voided and replaced with the following:

Welds shall be prepared for radiography by grinding and shall be radiographed after grinding and after backing is removed. If any reinforcement, within the specified tolerances remains after grinding, carbon steel shims shall be placed under the penetrometer so that the total thickness of steel between the penetrometer and the film is at least equal to the average thickness of the weld measured through its reinforcement.

#### 6.11 Acceptability of Welds

Article 6.11 is voided and replaced with the following:

6.11 Refer to Paragraph 9.21.6.

### **PART C ULTRASONIC TESTING OF GROOVE WELDS**

#### 6.13 General

Paragraph 6.13.1 is voided and replaced as follows:

The procedures and standards set forth in this Part C are to govern the ultrasonic testing of groove welds and heat affected zones between the thickness of 5/16 inch and 8 inches inclusive, when such testing is required by Article 6.7. These procedures and standards are not to be used for testing tube to tube T, Y, or K connections (see 10.17.4, AWS D1.1), but may be used as a basis for rejection of defective base metal.

### **SECTION 7 STUD WELDING**

#### 7.4 Workmanship

Paragraph 7.4.5 is voided and replaced as follows:

Longitudinal and lateral spacing of stud shear connectors with respect to each other and to edges of beam or girder flanges may vary a maximum of one inch) from the location shown in the drawings. If a row of shear connectors is located in the vicinity of a welded flange splice that row of shear connectors shall have its spacing adjusted so as to clear the heat affected zone of the flange. The minimum distance from the edge of a stud base to the edge of a flange shall be the diameter of the stud plus 1/8 inch but preferably not less than 1 1/2 inches. Other types of studs shall be so located as to permit a workmanlike assembly of attachments without alterations or reaming.

### **SECTION 9 DESIGN OF NEW BRIDGES**

### **PART D WORKMANSHIP**

#### 9.21 Quality of Welds

The following is added to Paragraph 9.21.5.1:

Restrained joints shall have testing delayed until after all welding is completed or shall be retested after all welding contributing to restraint is completed and cooled. The fabricator is responsible for specifying such joints on shop drawings or welding procedures.



Paragraph 9.21.6 is added as follows:

9.21.6 Weld Quality Acceptance

Welds shown by visual inspection, or by nondestructive testing in accordance with Article 6.7, to have defects prohibited by Paragraph 9.21.1, 9.21.2, or 9.21.3, shall be repaired or removed and replaced, by the methods permitted by Article 3.7, or the entire piece shall be rejected as determined by the Engineer. Repaired or replaced welds shall be reinspected by the applicable nondestructive testing method. All required repairs or replacements shall be at the Contractor's expense.

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